

# MARS GLOBAL SURVEYOR MAPPING ORBIT DETERMINATION

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Since the start of the mapping phase on March 9, 1999, the Mars Global Surveyor (MGS) spacecraft has been conducting a global scientific study of Mars' surface, atmosphere and magnetic and gravitational fields. The MGS mapping orbit is polar, nearly circular, frozen and sun synchronous. It has a period of 1.96 hours, with a mean altitude of 402 km. The primary mission ends on February 1, 2001, at which time MGS will have completed 8505 orbits during one Mars year of mapping flight operations. Throughout this time, the navigation team has been responsible for providing the MGS engineering and science teams with spacecraft predicted and reconstructed ephemeris information. This was derived by analyzing X-band Doppler tracking data. The methods and challenges of the orbit determination process are described in this paper.

The major challenges of the orbit determination have been the modeling of the Mars gravity field and the autonomous spacecraft angular momentum desaturations (AMDs). The Mars gravity field has been significantly improved over the last two years through the analysis of the MGS Doppler data. The AMDs have been frequent (three per day) and difficult to model. Furthermore, if not analyzed accurately, they can give rise to significant errors in the predicted time of future orbital events. For reconstruction, each AMD has been individually analyzed in the orbit determination process. For prediction, the AMDs are currently being modeled as an average perturbative acceleration. This procedure has worked well during the past half year. Typical equator crossing timing errors after seven days of prediction have been less than three seconds. However, any change in the character of the AMDs can increase these timing errors. Future Mars orbiters may benefit from the MGS experience, in particular, when analyzing AMD type perturbations.

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